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COMMENTED VERSION

Roterande elektriska maskiner – Del 18-1: Funktionsutvärdering av isolersystem – Allmänna riktlinjer

*Rotating electrical machines –
Part 18-1: Functional evaluation of insulation systems –
General guidelines*

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COMMENTED VERSION

INTERNATIONAL STANDARD



Rotating electrical machines – Part 18-1: Functional evaluation of insulation systems – General guidelines

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES –

Part 18-1: Functional evaluation of insulation systems – General guidelines

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
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This commented version (CMV) of the official standard IEC 60034-18-1:2022 edition 3.0 allows the user to identify the changes made to the previous IEC 60034-18-1:2010 edition 2.0. Furthermore, comments from IEC TC 2 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 60034-18-1 has been prepared by IEC technical committee 2: Rotating machinery. It is an International Standard.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) provides general guidelines for functional evaluation of different types of windings as before but incorporates those changes, which have been introduced for the electrical qualification and evaluation of windings which are electrically stressed by converter-supply;
- b) is now focused on general guidelines with all technical details of procedures and qualification principles moved to the subsequent parts;
- c) details additional general aspects of functional evaluation and qualification, particularly the procedure for comparison between reference and candidate insulation systems, the introduction of the concept of qualification for different expected life-times in service and the evaluation of minor component or manufacturing changes.

The text of this International Standard is based on the following documents:

Draft	Report on voting
2/2113/FDIS	2/2118/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60034 series, published under the general title *Rotating electrical machines*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

IEC 60034-18 comprises several parts, dealing with different types of functional evaluation and special kinds of test procedures for insulation systems of rotating electrical machines. IEC 60034-18-1 provides general guidelines for such procedures and qualification principles, whereas the subsequent parts IEC 60034-18-21, ~~IEC 60034-18-22~~, IEC 60034-18-31, IEC 60034-18-32, IEC TS 60034-18-33, IEC 60034-18-34, IEC 60034-18-41 and IEC 60034-18-42 give detailed procedures for the various types of windings. Beyond that, part IEC 60034-18-41 and IEC 60034-18-42 contain special test procedures for electrical evaluation of windings electrically stressed by converter-supply.

The following standards provide the basis and background for the development of the aforementioned standards.

IEC 60505 establishes the basis for estimating the ageing of electrical insulation systems under conditions of either electrical, thermal, mechanical, environmental stresses or combinations of these (multifactor stresses). It specifies the general principles and procedures that should be followed defining functional test and evaluation procedures.

The IEC 60216 series deals with the determination of thermal endurance properties of single insulating materials. On the assumption, that the Arrhenius formulas describe the rate of thermal ageing of the materials, test procedures and analyzing instructions for getting characteristic parameters like the “Temperature index” (TI), the “Halving interval” (HIC) and the “Relative thermal endurance index” (RTE) are given. For all these parameters selected properties and accepted end-point-criteria are specified. Consequently, a material may be assigned with more than one temperature index, derived from the measurement of different properties and the use of different end-point criteria.

IEC 60034-18-1 defines general requirements on the qualification of insulation systems, where – for thermal ageing – the Arrhenius equations do not necessarily fit, according to many experiences.

IEC 60085 deals with thermal evaluation of electrical insulation materials and in particular insulation systems used in electrical equipment. In particular, thermal classes of insulation systems are defined and designations are given, such as 130 (B), 155 (F) and 180 (H) for use in rotating machines belonging to IEC 60034-1. In the past, materials for insulation systems were often selected solely on the basis of thermal endurance of individual materials performed according to the IEC 60216 series. However, IEC 60085 recognizes that such selection may be used only for screening materials prior to further functional evaluation of a new insulation system which is not service-proven. Evaluation is performed on the basis of a comparison with a service-proven reference insulation system. Service experience is the preferred basis for assessing the thermal endurance of an insulation system.

IEC 62539 defines statistical methods to analyse times to breakdown and breakdown voltage data obtained from electrical testing of solid insulation materials, for the purposes of characterization of the system and comparison with other insulation systems. The methods of analysis are described for the Weibull-distribution, but other distributions are also presented.

ROTATING ELECTRICAL MACHINES –

Part 18-1: Functional evaluation of insulation systems – General guidelines

1 Scope

This part of IEC 60034 deals with the general guidelines for functional evaluation of electrical insulation systems, used or proposed to be used in rotating electrical machines within the scope of IEC 60034-1, in order to qualify them.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-18-21, *Rotating electrical machines – Part 18-21: Functional evaluation of insulation systems – Test procedures for wire-wound windings – Thermal evaluation and classification*

~~IEC 60034-18-22, *Rotating electrical machines – Part 18-22: Functional evaluation of insulation systems – Test procedures for wire-wound windings – Classification of changes and insulation component substitutions*~~

IEC 60034-18-31, *Rotating electrical machines – Part 18-31: Functional evaluation of insulation systems – Test procedures for form-wound windings – Thermal evaluation and classification of insulation systems used in rotating machines up to and including 50 MVA and 15 kV*

IEC 60034-18-32, *Rotating electrical machines – Part 18-32: Functional evaluation of insulation systems (Type II) – Test procedures for form-wound windings – Evaluation of electrical endurance of insulation systems used in machines up to and including 50 MVA and 15 kV Electrical endurance qualification procedures for form-wound windings*

IEC TS 60034-18-33, *Rotating electrical machines – Part 18-33: Functional evaluation of insulation systems – Test procedures for form-wound windings – Multifactor functional evaluation – endurance under combined thermal and electrical stresses of insulation systems used in machines up to and including 50 MVA and 15 kV Multifactor evaluation by endurance under simultaneous thermal and electrical stresses*

IEC 60034-18-34, *Rotating electrical machines – Part 18-34: Functional evaluation of insulation systems – Test procedures for form-wound windings – Evaluation of thermomechanical endurance of insulation systems*

IEC 60034-18-41:2014, *Rotating electrical machines – Part 18-41: Qualification and type tests for Type I electrical insulation systems used in rotating electrical machines fed from voltage converters* Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters – Qualification and quality control tests
IEC 60034-18-41:2014/AMD1:2019

IEC/TS 60034-18-42, *Rotating electrical machines – Part 18-42: ~~Qualification and acceptance tests for partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters~~ Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters – Qualification tests*

IEC 60034-27-3, *Rotating electrical machines – Part 27-3: Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines*

IEC 60085, *Electrical insulation – Thermal evaluation and designation ~~of electrical insulation~~*

~~IEC 60216 (all parts), Electrical insulating materials – Properties of thermal endurance~~

IEC 60493-1, *Guide for the statistical analysis of ageing test data – Part 1: Methods based on mean values of normally distributed test results*

IEC 60505:2004/2011, *Evaluation and qualification of electrical insulation systems*

IEC 61858-1:2014, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 1: Wire-wound winding EIS*

IEC 61858-2:2014, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 2: Form-wound EIS*

IEC 62539, *Guide for the statistical analysis of electrical insulation breakdown data*

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Roterande elektriska maskiner – Del 18-1: Funktionsutvärdering av isolersystem – Allmänna riktlinjer

*Rotating electrical machines –
Part 18-1: Functional evaluation of insulation systems –
General guidelines*

Som svensk standard gäller europastandarden EN IEC 60034-18-1:2023. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 60034-18-1:2023.

Nationellt förord

Europastandarden EN IEC 60034-18-1:2023

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 60034-18-1, Third edition, 2022 - Rotating electrical machines – Part 18-1: Functional evaluation of insulation systems – General guidelines**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60034-18-1, utg 2:2010 gäller ej fr o m 2026-01-26.

Standarder underlättar utvecklingen och höjer elsäkerheten

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Box 1284
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English Version

**Rotating electrical machines - Part 18-1: Functional evaluation of
insulation systems - General guidelines
(IEC 60034-18-1:2022)**

Machines électriques tournantes - Partie 18-1: Évaluation
fonctionnelle des systèmes d'isolation - Lignes directrices
générales
(IEC 60034-18-1:2022)

Drehende elektrische Maschinen - Teil 18-1: Funktionelle
Bewertung von Isoliersystemen - Allgemeine Richtlinien
(IEC 60034-18-1:2022)

This European Standard was approved by CENELEC on 2023-01-26. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 2/2113/FDIS, future edition 3 of IEC 60034-18-1, prepared by IEC/TC 2 "Rotating machinery" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60034-18-1:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-10-26
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-01-26

This document supersedes EN 60034-18-1:2010 and all of its amendments and corrigenda (if any).

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In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60216 (series) NOTE Approved as EN 60216 (series)

Annex A (normative)

Normative references to international publications with their corresponding European publications

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NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-1	-	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1 ¹	-
IEC 60034-18-21	-	Rotating electrical machines - Part 18-21: Functional evaluation of insulation systems - Test procedures for wire-wound windings - Thermal evaluation and classification	EN 60034-18-21	-
IEC 60034-18-31	-	Rotating electrical machines - Part 18-31: Functional evaluation of insulation systems - Test procedures for form-wound windings - Thermal evaluation and classification of insulation systems used in rotating machines	EN 60034-18-31	-
IEC 60034-18-32	-	Rotating electrical machines - Part 18-32: Functional evaluation of insulation systems (Type II) - Electrical endurance qualification procedures for form-wound windings	EN IEC 60034-18-32	-
IEC/TS 60034-18-33	-	Rotating electrical machines - Part 18-33: Functional evaluation of insulation systems - Test procedures for form-wound windings - Multifactor evaluation by endurance under simultaneous thermal and electrical stresses	CLC/TS 60034-18-33	-
IEC 60034-18-34	-	Rotating electrical machines - Part 18-34: Functional evaluation of insulation systems - Test procedures for form-wound windings - Evaluation of thermomechanical endurance of insulation systems	EN 60034-18-34	-

¹ Under preparation. Stage at the time of publication: FprEN 60034-1 and FprEN 60034-1/prAA.

EN IEC 60034-18-1:2023 (E)

IEC 60034-18-41	2014	Rotating electrical machines - Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters - Qualification and quality control tests	EN 60034-18-41	2014
+ A1	2019		+ A1	2019
IEC 60034-18-42	-	Rotating electrical machines - Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters - Qualification tests	EN 60034-18-42	-
IEC 60034-27-3	-	Rotating electrical machines - Part 27-3: Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines	EN 60034-27-3	-
IEC 60085	-	Electrical insulation - Thermal evaluation and designation	EN 60085	-
IEC 60493-1	-	Guide for the statistical analysis of ageing - test data - Part 1: Methods based on mean values of normally distributed test results		-
IEC 60505	2011	Evaluation and qualification of electrical insulation systems	EN 60505	2011
IEC 61858-1	2014	Electrical insulation systems - Thermal evaluation of modifications to an established electrical insulation system (EIS) - Part 1: Wire-wound winding EIS	EN 61858-1	2014
IEC 61858-2	2014	Electrical insulation systems - Thermal evaluation of modifications to an established electrical insulation system (EIS) - Part 2: Form-wound EIS	EN 61858-2	2014
IEC 62539	-	Guide for the statistical analysis of electrical insulation breakdown data	-	-

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Rotating electrical machines –
Part 18-1: Functional evaluation of insulation systems – General guidelines**

**Machines électriques tournantes –
Partie 18-1: Évaluation fonctionnelle des systèmes d'isolation – Lignes
directrices générales**

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- amended.

INTRODUCTION

IEC 60034-18 comprises several parts, dealing with different types of functional evaluation and special kinds of test procedures for insulation systems of rotating electrical machines. IEC 60034-18-1 provides general guidelines for such procedures and qualification principles, whereas the subsequent parts IEC 60034-18-21, IEC 60034-18-31, IEC 60034-18-32, IEC TS 60034-18-33, IEC 60034-18-34, IEC 60034-18-41 and IEC 60034-18-42 give detailed procedures for the various types of windings. Beyond that, part IEC 60034-18-41 and IEC 60034-18-42 contain special test procedures for electrical evaluation of windings electrically stressed by converter-supply.

The following standards provide the basis and background for the development of the aforementioned standards.

IEC 60505 establishes the basis for estimating the ageing of electrical insulation systems under conditions of either electrical, thermal, mechanical, environmental stresses or combinations of these (multifactor stresses). It specifies the general principles and procedures that should be followed defining functional test and evaluation procedures.

The IEC 60216 series deals with the determination of thermal endurance properties of single insulating materials. On the assumption, that the Arrhenius formulas describe the rate of thermal ageing of the materials, test procedures and analyzing instructions for getting characteristic parameters like the “Temperature index” (TI), the “Halving interval” (HIC) and the “Relative thermal endurance index” (RTE) are given. For all these parameters selected properties and accepted end-point-criteria are specified. Consequently, a material may be assigned with more than one temperature index, derived from the measurement of different properties and the use of different end-point criteria.

IEC 60034-18-1 defines general requirements on the qualification of insulation systems, where – for thermal ageing – the Arrhenius equations do not necessarily fit, according to many experiences.

IEC 60085 deals with thermal evaluation of electrical insulation materials and in particular insulation systems used in electrical equipment. In particular, thermal classes of insulation systems are defined and designations are given, such as 130 (B), 155 (F) and 180 (H) for use in rotating machines belonging to IEC 60034-1. In the past, materials for insulation systems were often selected solely on the basis of thermal endurance of individual materials performed according to the IEC 60216 series. However, IEC 60085 recognizes that such selection may be used only for screening materials prior to further functional evaluation of a new insulation system which is not service-proven. Evaluation is performed on the basis of a comparison with a service-proven reference insulation system. Service experience is the preferred basis for assessing the thermal endurance of an insulation system.

IEC 62539 defines statistical methods to analyse times to breakdown and breakdown voltage data obtained from electrical testing of solid insulation materials, for the purposes of characterization of the system and comparison with other insulation systems. The methods of analysis are described for the Weibull-distribution, but other distributions are also presented.

ROTATING ELECTRICAL MACHINES –

Part 18-1: Functional evaluation of insulation systems – General guidelines

1 Scope

This part of IEC 60034 deals with the general guidelines for functional evaluation of electrical insulation systems, used or proposed to be used in rotating electrical machines within the scope of IEC 60034-1, in order to qualify them.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-18-21, *Rotating electrical machines – Part 18-21: Functional evaluation of insulation systems – Test procedures for wire-wound windings – Thermal evaluation and classification*

IEC 60034-18-31, *Rotating electrical machines – Part 18-31: Functional evaluation of insulation systems – Test procedures for form-wound windings – Thermal evaluation and classification of insulation systems used in rotating machines*

IEC 60034-18-32, *Rotating electrical machines – Part 18-32: Functional evaluation of insulation systems (Type II) – Electrical endurance qualification procedures for form-wound windings*

IEC TS 60034-18-33, *Rotating electrical machines – Part 18-33: Functional evaluation of insulation systems – Test procedures for form-wound windings – Multifactor evaluation by endurance under simultaneous thermal and electrical stresses*

IEC 60034-18-34, *Rotating electrical machines – Part 18-34: Functional evaluation of insulation systems – Test procedures for form-wound windings – Evaluation of thermomechanical endurance of insulation systems*

IEC 60034-18-41:2014, *Rotating electrical machines – Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters – Qualification and quality control tests*
IEC 60034-18-41:2014/AMD1:2019

IEC 60034-18-42, *Rotating electrical machines – Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters – Qualification tests*

IEC 60034-27-3, *Rotating electrical machines – Part 27-3: Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60493-1, *Guide for the statistical analysis of ageing test data – Part 1: Methods based on mean values of normally distributed test results*

IEC 60505:2011, *Evaluation and qualification of electrical insulation systems*

IEC 61858-1:2014, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 1: Wire-wound winding EIS*

IEC 61858-2:2014, *Electrical insulation systems – Thermal evaluation of modifications to an established electrical insulation system (EIS) – Part 2: Form-wound EIS*

IEC 62539, *Guide for the statistical analysis of electrical insulation breakdown data*